OPERATING INSTRUCTIONS

F1 #3

TYPES 1209-B AND -BL

UNIT OSCILLATORS

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GENERAL RADIO COMPANY

OPERATING INSTRUCTIONS

TYPES 1209-B AND -BL

UNIT OSCILLATORS

Form 1209-0100-L
August, 1961

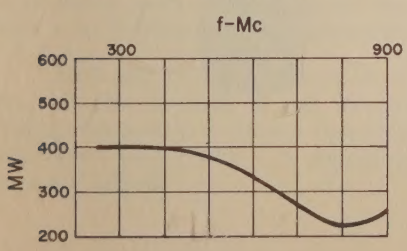
GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA

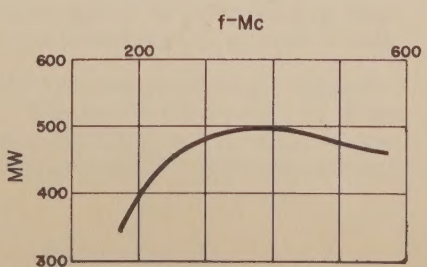
SPECIFICATIONS

Frequency Range:	Type 1209-BL: 180 to 600 Mc Type 1209-B: 250 to 960 Mc
Frequency Calibration Accuracy:	±1 percent.
Warmup Frequency Drift:	See Figure 2, page 4.
Frequency Control:	A four-inch dial with calibration over 270 degrees, with a slow-motion drive of about 8 turns.
Output System:	Short coaxial line with adjustable coupling loop at one end and coaxial connector on the other. Maximum power can be delivered to load impedances normally met in coaxial systems.
Output Power:	Type 1209-B: At least 200 mw into 50-ohm load at any frequency within range. Refer to curve below. Type 1209-BL: At least 300 mw into 50-ohm load at any frequency within range. Refer to curve below.
Modulation:	Plate modulation of 30% at audio frequencies can be produced by external source of 40 volts. Input impedance is about 8000 ohms. Type 1000-P6 Crystal Diode Modulator and Type 1000-P7 Balanced Modulator are recommended to avoid incidental fm. Refer to Table on page 3.
Tuned Circuit:	Butterfly, with no sliding contacts.
Power Supply Requirements:	330 v at 36 ma dc 6.3 v at 0.4 amp
Power Supply Recommended:	Refer to Table of Accessories, page 3.
Oscillator Tube:	Sylvania Type 6481
Mounting:	Aluminum casting surrounded by spun-aluminum shield. Assembly is mounted on L-shaped panel-and-chassis piece.
Accessories Supplied:	Type 874-R22 Cable, Type 874-C58 Cable Connector, and telephone plug.
Accessories Available:	Refer to Table on page 3.
Dimensions:	Width 9¼, height 6¼, depth 7 inches (235 by 160 by 180 mm), over-all.
Net Weight:	6¼ lb (2.8 kg).

GENERAL RADIO EXPERIMENTER references: Vol 29 No. 11, April, 1955
Vol 32 No. 8, January, 1958

U. S. Patent No. 2,548,457





Typical output characteristics of Types 1209-B (left) and 1209-BL (right) Unit Oscillators. Output with 300-v Type 1201 Unit Regulated Power Supply is reduced to about 0.6 of values shown. Outputs with Type 1216 or 1263 Power Supply are further reduced.

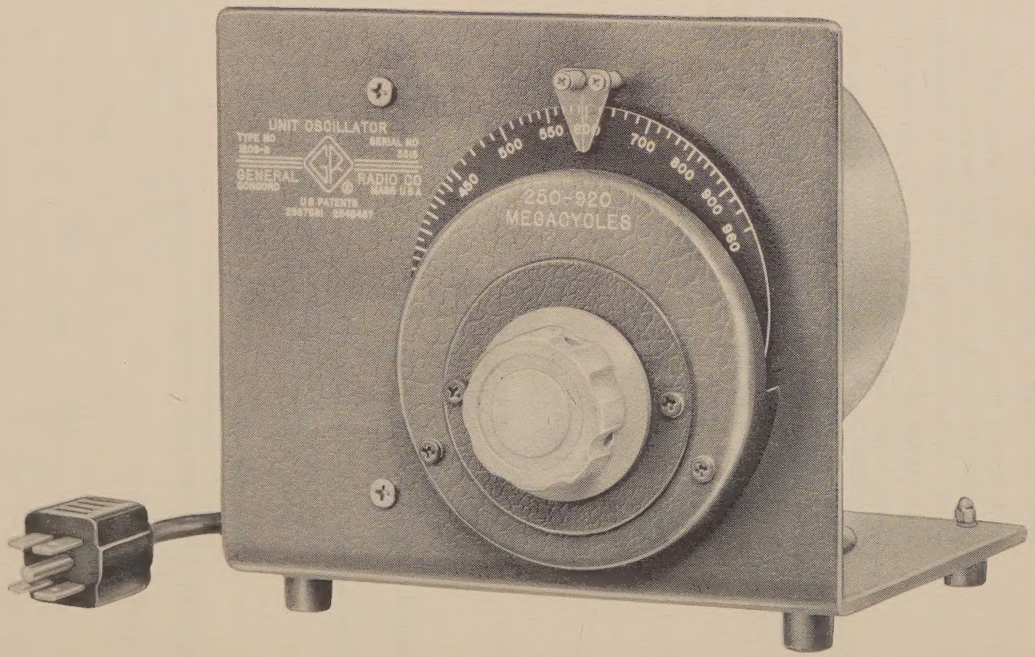


Figure 1. Type 1209-B Unit Oscillator
(Type 1209-BL identical in appearance except for dial calibration)

TYPES 1209-B AND 1209-BL UNIT OSCILLATORS

Section 1
INTRODUCTION

1.1 PURPOSE. The Types 1209-B and 1209-BL Unit Oscillators (Figure 1) are general-purpose radio-frequency power sources covering the ranges of 250 to 960 Mc and 180 to 600 Mc, respectively. These members of the convenient Unit Instrument line can be used to drive bridges, slotted lines, impedance comparators, and other measuring equipment. Used with a voltmeter and attenuator, they provide accurately known output voltages for the testing of receivers. Direct amplitude modulation is possible over the audio-frequency range, and amplitude modulation free from incidental fm can be obtained with a simple crystal-diode modulator from zero to 5 Mc. Connected to a mixer, the Unit Oscillator can be used as the local oscillator in a heterodyne receiver to convert the Type 1216-A Unit I-F Amplifier on a low-frequency communications receiver into a vhf or uhf detector. Pulsing and linear 100-percent amplitude modulation can be obtained with an external balanced modulator.

1.2 DESCRIPTION. The tuning system of the Type 1209-B Unit Oscillator is a "butterfly" circuit, which combines a variable air capacitor and a variable inductor in a single unit with no sliding contacts. Inductance varies from 0.012 μh at the low-frequency end to 0.004 μh at the high-frequency end, and capacitance varies from 40 μμf to 7 μμf. The inductance of the Type 1209-BL unit oscillator is exactly twice as large. The vernier dial requires about 8 turns to rotate the main dial over its full 270 degrees. The rotor of the tuning unit is geared down for 80-degree rotation. The frequency calibration is accurate within 1 percent.

With the exception of frequency and output-characteristic differences stated in the Specifications, the Types 1209-B and 1209-BL are identical to each other, and all information contained herein applies to both.

Plate and grid of the oscillator tube are connected to the tuned circuit, and the cathode is left floating. The oscillator circuit is of the Colpitts type, with feedback determined essentially by the electrode capacitances of the tube. A small amount of cathode-plate capacitance has been added.

The output system is a short coaxial line, with a coupling loop on one end and a Type 874 Coaxial Connector on the other. Coupling between the loop and the oscillator can be adjusted over a wide range, and the loop can be clamped in the desired position. Maximum power can be delivered to load impedances normally encountered in coaxial systems.

1.3 ACCESSORIES.

1.3.1 AMPLITUDE MODULATION. A simple audio oscillator can be connected in the plate circuit of the unit oscillator to give amplitude modulation over the audio-frequency range. The audio oscillator circuit must supply a d-c path and must be able to carry 30 milliamperes dc.

Plate modulation of the oscillator introduces some incidental frequency modulation. Incidental fm is considerably reduced if square-wave or pulse modulation is used instead of sinusoidal amplitude modulation, but the power required is large and the accessories are more complex and more expensive.

Amplitude modulation free from incidental fm can be obtained by means of a Type 1000-P6 Crystal Diode Modulator or Type 1000-P7 Balanced Modulator connected between oscillator and load.

1.3.2 SWEEP AND DIAL DRIVES. The frequency dial of the Type 1209-B Unit Oscillator can be mechanically swept back and forth by the Type 1750-A Sweep Drive, the Type 908-P Synchronous Dial Drive, or the Type 907-R Dial Drive.

The Sweep Drive can be coupled either to the slow-motion dial or to the main frequency dial of the Unit Oscillator. When the main frequency dial is coupled to the Sweep Drive, the sweep rate should be restricted to one excursion per second or less. The slow-motion dial can be driven at rates up to 5 cycles per second. The magnitude and center position of the sweep arc, as well as the sweep rate, can be set by controls on the Sweep Drive panel. The Sweep Drive also provides horizontal deflection voltage, proportional to shaft rotation, for an oscilloscope. The combination of a Type 1209-B Unit Oscillator, Sweep or Dial Drive, and Type 1263-A Amplitude-Regulating Power Supply is a versatile sweep generator for recording or oscilloscopic display of frequency characteristics.

When the Type 1209-B Unit Oscillator is driven by a sweep or dial drive, all moving parts in the oscillator must be lubricated in accordance with paragraph 4.4.

1.3.3 OTHER ACCESSORIES. Supplied with the Unit Oscillator are a 874-R22 three-foot coaxial double-shielded Patch Cord, a Type 874-P Panel Connector, a Type 874-C Cable Connector, a Jones socket, and a phone plug.

TABLE OF ACCESSORIES

Accessory and Function	Instrument	Remarks
POWER SUPPLIES		
Standard	Type 1203-B Unit Power Supply	115-v, 50-60-cps line
Stabilized plate voltage	Type 1201-A Unit Regulated Power Supply	105-125-v, 50-60-cps line (reduced output)
Adjustable regulated plate voltage	Type 1205-B Adjustable Regulated Power Supply	105-125 v, 60-cps line
Constant output level vs frequency	Type 1263 Amplitude-Regulating Power Supply with Type 874-VR Voltmeter Rectifier, Type 874-QN6 Adaptor, and Type 274-NO Patch Cord	115- or 230-v, 50-60-cps line (reduced output)
MODULATORS		
Plate modulation	Type 1214-A Unit Oscillator	400 and 1000 cps output, 115-v, 40-60-cps line
Square-wave or pulse modulation	Type 1219-A Unit Pulse Amplifier	Requires modulation source.
Square-wave or Pulse Modulation	Type 1264-A Modulating Power Supply	Requires Type 1264-P1 Adaptor Cable
Absorption modulation with no incidental fm	Type 1000-P6 Crystal-Diode Modulator	Requires modulation source. Modulation freq range 0-5 Mc. Maximum output 10 mv.
Balanced modulation for linear 100-percent amplitude modulation and for pulses with high degree of carrier suppression	Type 1000-P7 Balanced Modulator	Requires modulation source. Modulation frequency range 0-20 Mc.
SWEEP DRIVE		
Automatic frequency sweep	Type 1750-A Sweep Drive Type 908-P Synchronous Dial Drive Type 907-R Dial Drive	Type 1263 Amplitude-Regulating Power Supply recommended to keep oscillator output level constant.
RELAY RACK PANEL	Type 480-P4UC2	For Types 1203-B and 1209-B or for 1201-B and 1209-B
ADAPTORS - available for connecting Type 874 coaxial output terminals to other coaxial systems. See table at rear of manual.		

Section 2
OPERATING PROCEDURE

2.1 INSTALLATION. The Type 1209-B Unit Oscillator, when connected to a suitable power supply, is ready for use. A cord and connector are supplied with the instrument for direct connection to a General Radio Unit Power Supply. Connect the oscillator to the equipment under test by means of the three-foot coaxial cable supplied. If necessary, install one of the two connectors supplied on the equipment under test; or use one of the many adaptors available for various coaxial systems.

If a power supply other than a Unit Power Supply is used, it should be capable of supplying 330 volts at 36 milliamperes and 6.3 volts at 0.4 ampere. To reduce these requirements, the series and shunt resistors in the base of the oscillator could be disconnected, but care must be taken not to overload the tube under various operating conditions. Plate dissipation of the oscillator tube should be limited to 5 watts, and best operation will be obtained with a plate current of 30 milliamperes at 165 volts.

2.2 OPERATION. After turning on the power supply, adjust the frequency by means of the frequency dial, and adjust the output by rotating the output coupling loop. For low output the coupling loop can be partly withdrawn.

The frequency of the oscillator varies for some time after the power has been applied, until the temperature has stabilized. This warmup drift is usually well under ±0.2%. It depends on frequency and varies considerably from one oscillator to the other. A representative curve of warmup drift is shown in Figure 2.

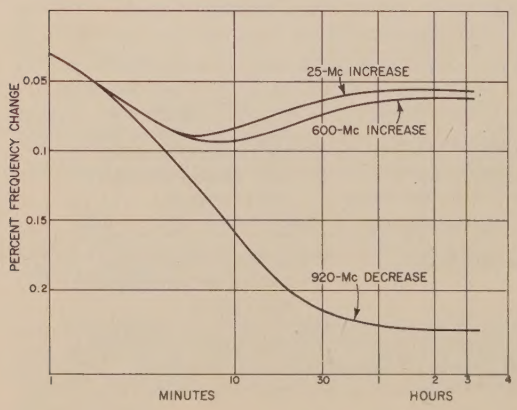


Figure 2.
Typical Warmup
Drift Rate
of Oscillator

For plate modulation the audio modulating voltage should be inserted at the jack at the side of the base. Full plate current must flow through the modulating source. A modulating voltage of about 40 volts is required for 30-percent modulation. The input impedance is about 8000 ohms.

2.3 FREQUENCY DEVIATION. For some applications a well-regulated and filtered power supply should be used to avoid frequency variations caused by line-voltage fluctuation and to produce a clearer beat note at the highest frequencies. With an unregulated power supply, a line-voltage variation of 20 percent causes a frequency change of about 0.01 percent at frequencies up to 600 Mc, and a frequency change of about 0.05 percent at the top end of the frequency range.

As mentioned above, amplitude modulation over the audio range can be obtained by an audio-frequency voltage superimposed in the d-c power supply. Incidental fm, inherent in this system, is about 0.01 percent for 50-percent amplitude modulation at carrier frequencies up to 400 Mc, and 0.1 percent at the high-frequency end.

2.4 SQUARE-WAVE AND PULSE MODULATION. The rise time of the Type 1209-B Unit Oscillator depends on frequency and load conditions, and is never adequate to reproduce short pulses faithfully. However, modulation with square waves and long pulses might be desirable for applications where incidental fm has to be kept to a minimum.

For best results, the plate power supply should be disconnected. Then ground the junction of inductors L1 and L2 in the r-f compartment and introduce square waves or pulses at the modulation jack. With 150 volts at 20 to 30 ma, either pulses or square waves, output will be the same as that obtainable with a Unit Power Supply. A Type 1219-A Unit Pulse Amplifier driven by a Type 1210-C Unit R-C Oscillator for square waves or by a Type 1217-A Unit Pulser would be suitable for this purpose.

Section 3
APPLICATIONS

3.1 GENERAL. The utility and versatility of the Type 1209-B Unit Oscillator are greatly increased by the large selection of Type 874 coaxial elements, available from General Radio Company. These elements are part of a complete, integrated line of equipment for the measurement of voltage, power, and standing-wave ratio at very-high and ultra-high frequencies. Although the Unit Oscillator is intended primarily as a source of power for this measuring equipment and for other impedance-measuring devices such as the Type 1602-A U-H-F Admittance Meter, use of the coaxial elements can adapt the Unit Oscillator to various applications in the radio-frequency laboratory in place of more expensive equipment that is not always available. The tuning circuit of the Type 1209-B

Unit Oscillator uses ball bearings, and thus can be motor-driven, for sweep applications, by sweep and dial drives (refer to paragraph 1.3.2).

Three applications are described in detail in the following paragraphs. Others will be suggested by a study of the complete list of Type 874 Coaxial elements, included in the General Radio Catalog. A condensed list of Type 874 elements appears in the rear of this manual.

3.2 UNIT OSCILLATOR AS SIGNAL GENERATOR FOR RECEIVER TESTING. The Type 1209-B Unit Oscillator, as a well-shielded power source, can be used as a signal generator to test receivers if means are available to measure and attenuate the output. The Type 874-VR Voltmeter Rectifier, Type 874-VI Voltmeter Indicator, and Type 874-GA Adjustable Attenuator are suitable for this purpose, and should be connected to the Unit Oscillator as shown in Figure 3. Also, a Type 874-D50 Adjustable Stub is required to produce a current maximum at that point of the attenuator where the adjustable output loop is coupled. A tuning

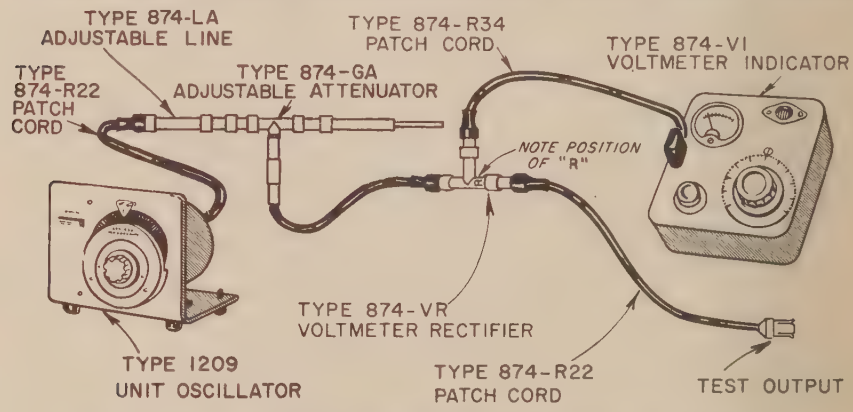


Figure 3. Setup of Unit Oscillator and Accessories for Use as Standard-Signal Generator.

element between the oscillator and the attenuator is required to increase the output to a value that can be read on the voltmeter. At higher frequencies coverage is obtained by a Type 874-LA Adjustable Line. At lower frequencies additional lengths of line must be used.

Current from the Unit Oscillator is fed through the attenuator into the short circuit at the stub. The attenuator is calibrated in decibels. At minimum attenuation the attenuator output is measured by a crystal diode in the voltmeter rectifier and read on the meter of the voltmeter indicator. Means are provided to standardize the crystal indication. A 50-ohm resistor after the crystal determines the output impedance.

With the above-described arrangement, the maximum available output is several tenths of a volt. The attenuator calibration covers 120 db, but shielding of the Unit Oscillator and of other components is not sufficient for accurate measurements in the microvolt region.

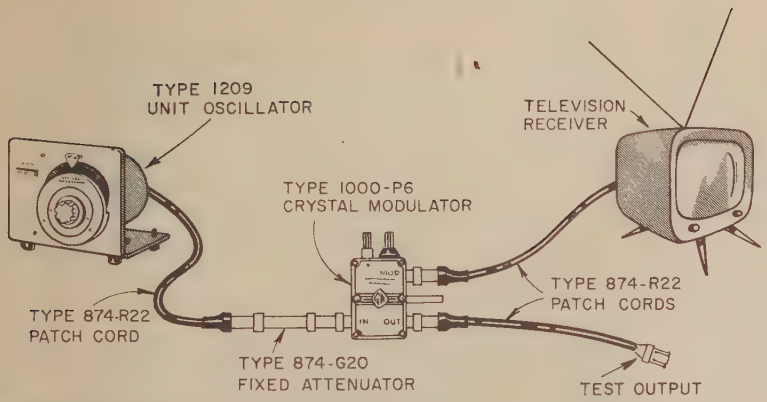


Figure 4. Setup of Unit Oscillator with Video Modulator for Use as Television Signal Generator.

3.3 UNIT OSCILLATOR AS A TELEVISION SIGNAL GENERATOR. Used in combination with a Type 1000-P6 Crystal Diode Modulator and a Type 874-G20 20-db Fixed Attenuator, the Unit Oscillator is a convenient source of television signals over its entire carrier-frequency range if video modulating voltage is available. (see Figure 4.) The modulating voltage required can be obtained from a standard television receiver tuned to the local channel.

Since the modulator and oscillator are separated from each other by an attenuator pad, amplitude modulation is free from incidental fm. Output is about 10 millivolts.

3.4 UNIT OSCILLATOR AS A FREQUENCY CONVERTER. Connected to a Type 874-MR Mixer Rectifier, the Unit Oscillator can provide the local signal in a heterodyne converter to adapt the Type 1216-A Unit I-F Amplifier for use as a sensitive detector for v-h-f and u-h-f signals. (See Figure 5.) Without additional tuning, the conversion loss is about 6 db at an intermediate frequency of 30 Mc. The Type 1216-A I-F Amplifier has a built-in precision attenuator and a panel meter. Its bandwidth is 0.7 Mc and it has excellent sensitivity. Provision is made for the measurement of the rectified mixer current in the i-f amplifier,

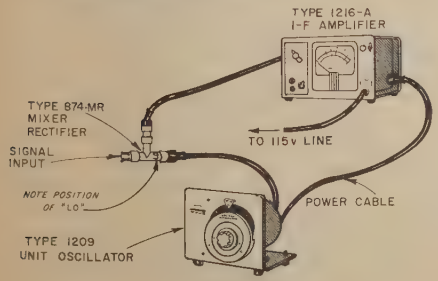


Figure 5. Setup of Unit Oscillator and Mixer Rectifier for Use as Frequency Converter.

and a separate built-in power supply is available for operating the Unit Oscillator.

For the vhf range of 50-250 Mc, the Type 1215-B Unit Oscillator is an excellent companion instrument to the Type 1209-B. The two oscillators are similar in appearance and construction.

3.5 UNIT OSCILLATOR USED FOR FREQUENCY MEASUREMENT. The oscillator can be used as a heterodyne frequency meter of limited accuracy, or as a transfer oscillator for precision measurement of the frequency of a microwave source. The wide tuning range is particularly well suited to this application.

Auxiliary equipment required, in addition to a power supply, includes a Type 1232-A Amplifier, a Type 874-VR Voltmeter Rectifier, a Type 874-G10 pad, a Type 874-R34 patch cord, and two patch cords such as Type 874-R22 for connection to the signal source and frequency-measuring equipment. The necessary connections are shown in Figure 6.

The oscillator should be tuned to zero beat with the source at two or more points on the dial, noting the frequencies of a pair of successive, strong beats.

Let: f_s = the source frequency
f_h = the higher frequency of two successive, strong beats
f_l = the lower frequency of two successive, strong beats
$f_d = f_h - f_l$ = the difference between these two frequencies
H = the harmonic order of the source frequency relative to the lower beat frequency (always an integer).

Then $f_s = H f_l = (H - 1) f_h$

from which $H = \frac{f_h}{f_h - f_l} = \frac{f_h}{f_d}$, which may be substituted in the preceding equation to give f_s.

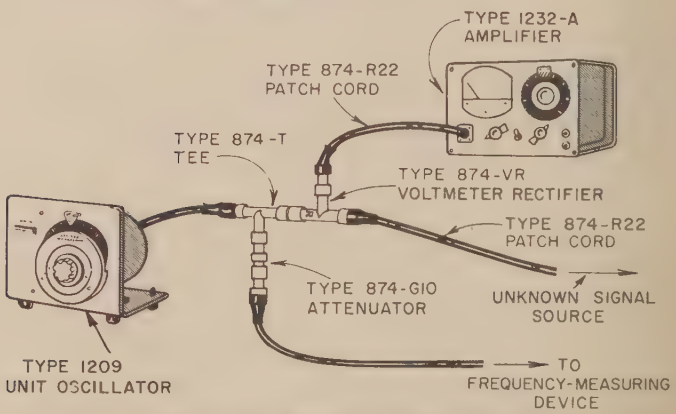


Figure 6. Setup for Frequency Measurement.

For example, suppose a strong beat is observed at 500 Mc (f_l) and the next is found at 750 Mc (f_h). Then f_d = 250 Mc, $H = \frac{750}{250} = 3$ and f_s =3 x 500 = 1500 Mc.

For precision frequency measurement, the frequency f_l of the Type 1209 Unit Oscillator should be measured while beating with the unknown. A frequency counter with suitable range extenders or a heterodyne frequency meter can be used for this purpose.

Section 4
SERVICE AND MAINTENANCE

4.1 GENERAL. The two-year warranty given with every General Radio instrument attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible.

In case of difficulties that cannot be eliminated by the use of these service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest district office (see back cover), requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.2 INSTALLATION OF OSCILLATOR TUBE. When it is necessary to replace the Type 6481 oscillator tube, install the new tube as follows (see Figure 7):

a. Remove the screw holding the plate clamp.

b. Loosen the grid clamp strap until the tube can be slid into position. Place the cathode connection just short of the filament clip.

c. Carefully tighten the grid clamp by bending the ends of the grid clamp strap.

d. Replace the plate screw and carefully tighten the plate clamp.

CAUTION

Be careful when tightening clamps. Glass seals are fragile.

e. Restore frequency calibration, if necessary, in accordance with paragraph 4.3.

4.3 FREQUENCY CALIBRATION. Replacement of the oscillator tube may affect frequency calibration. It can be restored by adjustment of one of the flexible tabs on the feedback ring. Before adjusting this trim-

mer capacitor, allow the instrument to warm up, since warmup drift may be as much as 0.2 percent. The oscillator shield affects frequency considerably, especially at the low-frequency end.

4.4 LUBRICATION. When the Type 1209 Unit Oscillator is driven by a sweep or dial drive, all moving parts must be properly lubricated. Proper lubrication includes an occasional drop of light oil at the ball bearings, and occasional relubrication of the pinion gear in the dial assembly.

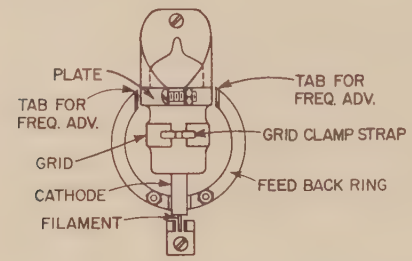
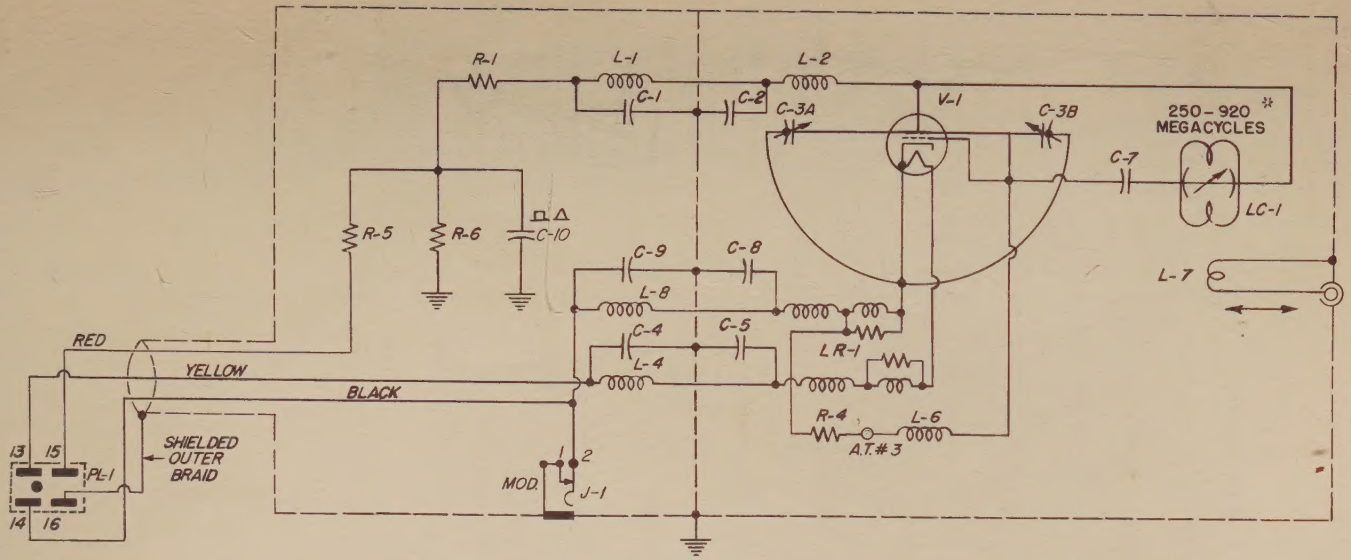


Figure 7. Installation Detail of Oscillator Tube.

PARTS LIST

REF DESIG	DESCRIPTION	PART NO.
C1	CAPACITOR, Fixed mica, 200 μμf ±10%	COU-24
C2	CAPACITOR, Fixed mica, 200 μμf ±10%, 500 dcwv	COU-8-2
C3A	CAPACITANCE, Built-in air adjustment	
C3B	CAPACITANCE, Built-in air adjustment	
C4	CAPACITOR, Fixed mica, 500 μμf ±10%	COU-24
C5	CAPACITOR, Fixed mica, 500 μμf ±10%, 500 dcwv	COU-8-2
C7	CAPACITOR, Fixed mica, 10 μμf, built-in	
C8	CAPACITOR, Fixed mica, 500 μμf ±10%, 500 dcwv	COU-8-2
C9	CAPACITOR, Fixed mica, 500 μμf ±10%	COU-24
C10	CAPACITOR, Fixed electrolytic, 20 μf +100% -10%, 450 dcwv	COE-5
J1	JACK	CDSJ-10
L1	INDUCTOR, 45 μh	ZCHA-9
L2	INDUCTOR, 45 μh	ZCHA-9
L4	INDUCTOR, 20 μh	ZCHA-29
L6	INDUCTOR, 45 μh	ZCHA-9
L7	INDUCTOR (R-F pickup loop)	874-403
L8	INDUCTOR, 20 μh	ZCHA-29
LC1	BUTTERFLY, 250 - 920 Mc, built in	
LR1	HEATER FILTER	1021-216
PL1	PLUG	1209-34
R1	RESISTOR, Fixed, wire-wound, 560Ω ±5%, 2 w	REW-6C
R4	RESISTOR, Fixed composition, 1 k ±10%, 1/2 w	REC-20BF
R5	RESISTOR, Fixed power, 4.7 k ±5%, 10 w	REPO-22
R6	RESISTOR, Fixed composition, 21.5 k ±10% (two 43-k ±5% resistors in parallel), 2 w	REC-41BF



* Type 1209-BL: 180-600 Mc

TUBE

V-1 Sylvania 6481

Figure 7. Schematic Diagram of Type 1209-B Unit Oscillator.

TYPE 874 COAXIAL COMPONENTS

TYPE 874- CONNECTORS

CONNECTOR TYPE	CABLE TYPE				
	874-A2	874-A3 RG-29/U RG-55/U RG-58/U RG-58A/U	RG-8/U	RG-9/U RG-116/U	RG-59/U RG-116/U
CABLE	-C	-C58	-C8	-C9	-C62
CABLE LOCKING	-CL	-CL58	-CL8	-CL9	-CL62
PANEL	-P	-P58	-P8	-P8	-P62
PANEL, FLANGED	-PB	-PB58	-PB8	-PB8	-PB62
PANEL, LOCKING	-PL	-PL58	-PL8	-PL8	-PL62
PANEL, LOCKING RECESSED	-PRL	-PRL58	-PRL8	-PRL8	-PRL62

Example: For a locking cable connector for RG-8/U, order Type 874-CL8.

TYPE 874- ADAPTORS

TO TYPE		874-	TO TYPE		874-
BNC	plug	QBJA QBJL*	TNC	plug	QTNJ QTNJL*
	jack	QBPA		jack	QTNP
C	plug	QCJA QCJL*	UHF	plug	QUJ QUJL*
	jack	QCP		jack	QUP
HN	plug	QHJA	double plug or jack		Q2
	jack	QHPA	binding post pair		Q9
LC	plug	QLJA QLPA	UHF 7/8-in. Air 1-5/8-in. Line 3-1/8-in.		QU1A QU2 QU3A
LT	plug	QLTJ			
	jack	QLTP			
N	plug	QNJA QNJL*			
	jack	QNP			
SC	plug	QSCJ QSCJL*			
	jack	QSCP			

*Locking Type 874 Connector.

Example: To connect Type 874 to a Type N jack, order Type 874-QNP.

OTHER COAXIAL ELEMENTS

Type 874-	
A2	50 Ω cable (low loss)
A3	50 Ω cable
D20, D50	20-, 50-cm adjustable stubs
EL	90° ell
F185	185-Mc low-pass filter
F500	500-Mc low-pass filter
F1000	1000-Mc low-pass filter
F2000	2000-Mc low-pass filter
F4000	4000-Mc low-pass filter
G3, G6 G10, G20	3-, 6-, 10-, & 20-db attenuators
GA	adjustable attenuator
JR	rotary joint
K	coupling capacitor
L10, L20, L30	10-, 20-, & 30-cm rigid air lines
LA	33-58 cm adjustable line
LK10, LK20	constant-Z adjustable lines
LR	radiating line
LT	trombone constant-Z line
M	component mount
MB	coupling probe
MR	mixer-rectifier
T	tee
UB	balun
VC	variable capacitor
VI	variable indicator
VQ	voltmeter detector
VR	voltmeter rectifier
W100	100-Ω termination
W200	200-Ω termination
WM	50-Ω termination
WN, WN3	short-circuit terminations
WO, WO3	open-circuit terminations
X	insertion unit
Y	cliplock
Z	stand

The above is a partial listing. For complete details, refer to the General Radio catalog.

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

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